

Monitoring visual attention on a neurorehabilitation environment based on Interactive Video

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1. INTRODUCTION

The use of new technologies in neurorehabilitation has led to higher intensity rehabilitation processes, extending therapies in an economically sustainable way. Interactive Video (IV) technology allows therapists to work with virtual environments that reproduce real situations. In this way, patients deal with Activities of the Daily Living (ADL) immersed within enhanced environments [1]. These rehabilitation exercises, which focus in re-learning lost functions, will try to modulate the neural plasticity processes [2].

This research presents a system where a neurorehabilitation IV-based environment has been integrated with an eye-tracker device in order to monitor and to interact using visual attention. While patients are interacting with the neurorehabilitation environment, their visual behavior is closely related with their cognitive state, which in turn mirrors the brain damage condition suffered by them [3] [4]. Patients' gaze data can provide knowledge on their attention focus and their cognitive state, as well as on the validity of the rehabilitation tasks proposed [5].

2. METHODS

Interactive Video (IV)

IV refers to any video whose sequences and displayed information depend on the user's responses. Interactivity is provided by associating an interaction with any element which appears in the video scenes. The regions where those elements are located are called hot spots; the video flow is modified according to the way users interact with them.

The ADL “buying bread” was developed using IV technology [6]. Patients navigate through a series of scenes representing the different steps which they have to follow in order to reach a final goal, from sitting on the couch at home (initial state) to buying bread at the bakery (end state). Throughout the task, patients are required to make decisions: choosing the next step, answering questions or interacting with other characters.

Every single action in the task is under therapist control, who has previously adjusted the video to the cognitive capabilities that will be required of the patient. Thus, all stimuli in the scenes may be preprogrammed by therapists in order to help the patient or even distract him/her from completing a task.

Eye-tracker

Tobii 1750 is used as an eye-tracker device [7]. The system can provide time-stamped data on the position (x,y) of the user's gaze focus, the distance between device and user or the user's pupils diameter. More interestingly, parameters such as patient's gaze fixation areas and duration, as well as the instants when saccade movements occur, can be obtained.

3. RESULTS

Figure 1 shows the proposed integration schema for using Tobii's libraries from the IV web application.

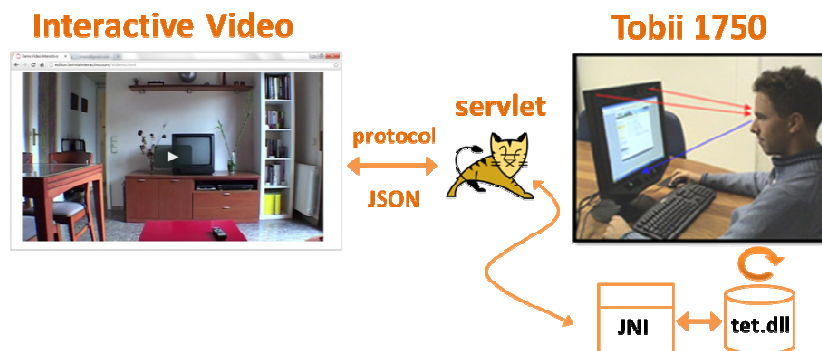


Figure 1 System description

Tomcat servlet allows sending and receiving the necessary requests in an effective way, developing a communication protocol between servlet and web application. This protocol consists of several requests: start/ stop tracking session; start/ stop tracking data acquisition; start/ stop tracking scene data acquisition; and query about user's instantaneous attention.

Thus, the system captures visual attention data while the patient is performing the activity. Tracking data are stored in both a global file and a set of individual files for each played video scene. Heat maps can be obtained for every frame visually representing the areas where a patient pays more visual attention (Fig. 2).

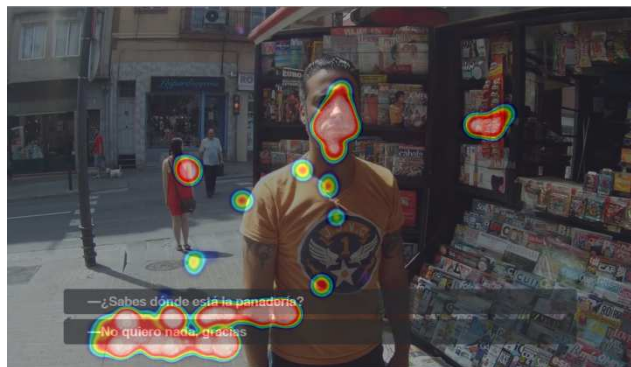


Figure 2 Heat Map

On the other hand, system is capable of detecting attention deficits when patients close their eyes or look away from the screen. The environment will respond to these situations showing new stimuli according to therapists' instructions, trying to retain/recover their attention.

4. CONCLUSIONS

This research describes a system to acquire visual attention data while a patient is carrying out an ADL using a virtual environment based on IV technology. Therapists extract useful information about how patients have performed their rehabilitation tasks, being able to reproduce where patients focused their gaze. Additionally, objective data on stimuli most visualized by them can be obtained, which could provide the basis for a reliable assessment of their performance. Moreover, the ability to detect attention deficits could serve as a trigger to modify the task flow in order to hold patient's attention on the important stimuli.

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